On Emittance Growth measurements during HEP.

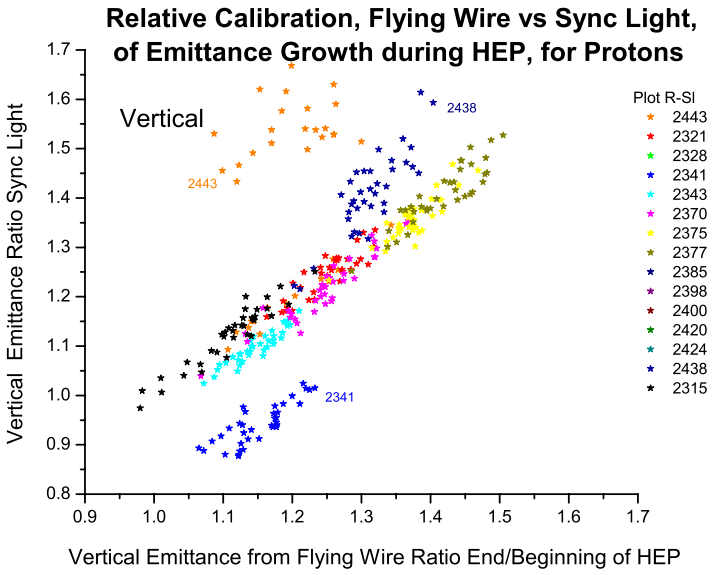
The Sync Light (SL) monitors the transvserse sizes of the bunches during the store. However, we do not understand the "emittance scale factor" for both the Flying Wire (FW) and the SL. That is, the effective emittance (obtained from the Luminosity counters at CDF or D0 and the somewhat more reliable (i.e., cross-calibrated with the Toroids) Fast Bunch Integrator) differs significantly from the emitance obtained from the FW by ~20 to 30 %, ~40%, or more for SL. The problem is particularly acute for the Pbar.

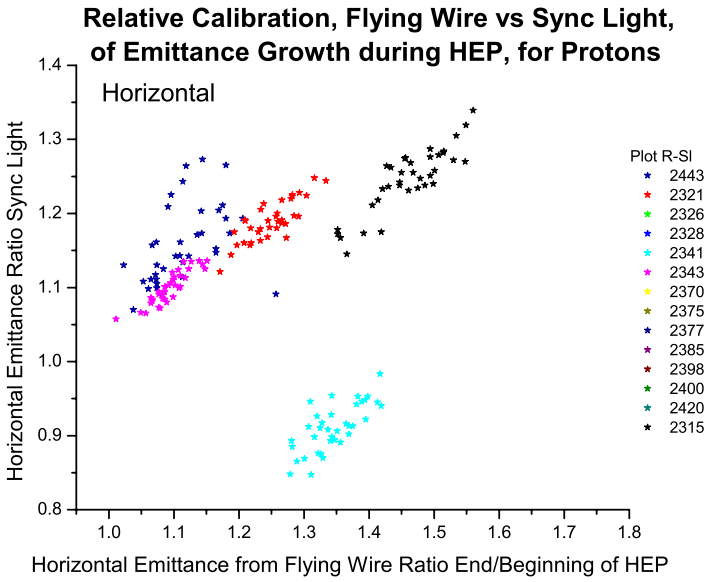
We reported on emittance growth during the early HEP phase of the stores and compared these emittance growth factors with a diffusion model, where IBS is the dominant contribution. This analysis was based on the SL. Since we now fly the wire at the end of each store – provide we have a "normal termination -, we now can compare the emittance growth during the entire HEP phase of the store, reported by FW, to the one reported by Sync Light.

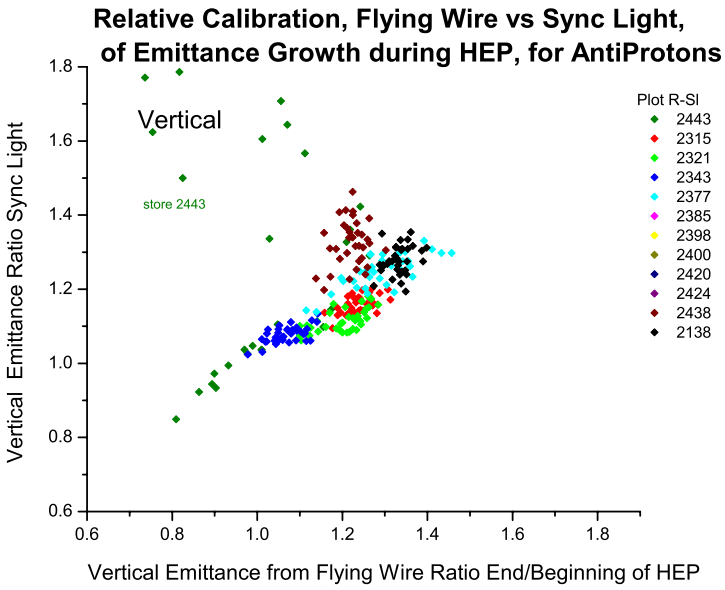
As suggested by Valery Lebedev, if this transverse emittance discrepency is simply due to a fixed, constant during the store, multiplicative scale factor, the ratio of the emittance End/Beginning of HEP reported by the FW should agree, within measurement errors, to the similar ratios reported by SL. Conversely, if the scale factors are not multiplicative, as it was due to some misestimated diffraction effects, these ratios will depend on the emittance growths factors.

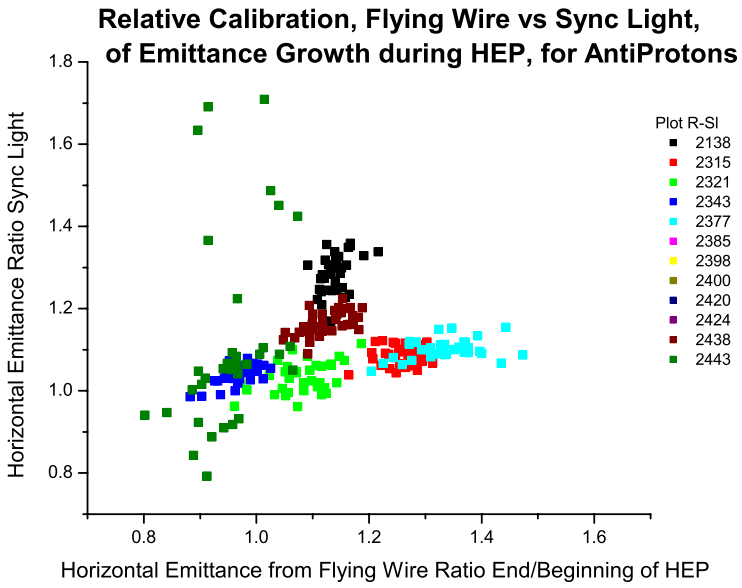
The Vertical Emittances are computed assuming that there is no dispersion in the vertical plane. Thus, only two detectors (FW, SL) are required to do this analysis. In order to boost the precision of the SL measurement, we average for 10 minutes at the beginning and 10 min at the end of the store. For the Horizontal measurements, we unfortunately need the SBD data. Note also that many stores don't finish gracefully, and/or we perform destructive end of store studies. After a cursory look through the e-logs, we rejected a few stores. Note also that many stores are missing because failures of the D44 archiver, or D.A., or the wire did not flew at the end of the store.

Results are shown in the figures. In the vertical plane, proton beam, for stores 2343, 2377, 2315,.. , we have in fact good agreement, in the sense that the relative emittance growth FW, SL, do agree within expected measurement errors. Stores 2443, 2348 and 2341 are anomalous: the relative emittance growth rate reported by FW and SL disagree by almost a factor 2 . It is therefore no longer surprising that the comparison with IBS prediction fails sometimes by that ratio. The store to store fluctuations of these ratios is not currently understood.


Relative Calibration, Flying Wire vs Sync Light,
of Emittance Growth during HEP, for Protons
Vertical
2443
2438
2341
Plot R-Sl
2443
2321
2328
2341
2343
2370
2375
2377
2385
2398
2400
2420
2424
2438
2315
Vertical Emittance Ratio Sync Light
Vertical Emittance from Flying Wire Ratio End/Beginning of HEP


Relative Calibration, Flying Wire vs Sync Light,
of Emittance Growth during HEP, for Protons
Horizontal
Plot R-Sl
2443
2321
2326
2328
2341
2343
2370
2375
2377
2385
2398
2400
2420
2315
Horizontal Emittance Ratio Sync Light
Horizontal Emittance from Flying Wire Ratio End/Beginning of HEP


Relative Calibration, Flying Wire vs Sync Light,
of Emittance Growth during HEP, for AntiProtons
Vertical
store 2443
Plot R-SI
2443
2315
2321
2343
2377
2385
2398
2400
2420
2424
2438
2138
Vertical Emittance Ratio Sync Light
Vertical Emittance from Flying Wire Ratio End/Beginning of HEP
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.6
0.8
1.0
1.2
1.4
1.6
1.8


Relative Calibration, Flying Wire vs Sync Light,
of Emittance Growth during HEP, for AntiProtons
Plot R-SI
2138
2315
2321
2343
2377
2385
2398
2400
2420
2424
2438
2443
Horizontal Emittance Ratio Sync Light
Horizontal Emittance from Flying Wire Ratio End/Beginning of HEP
1.8
1.6
1.4
1.2
1.0
0.8
0.8
1.0
1.2
1.4
1.6